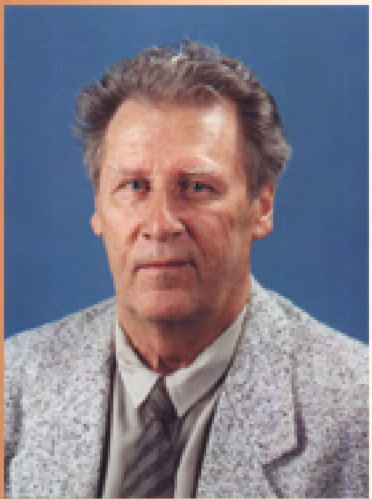

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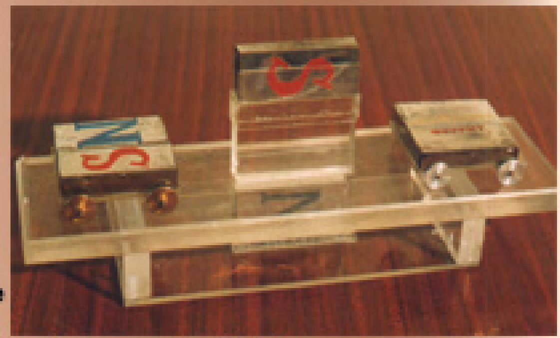
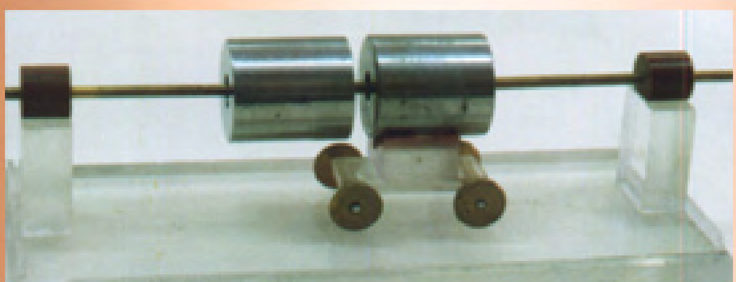
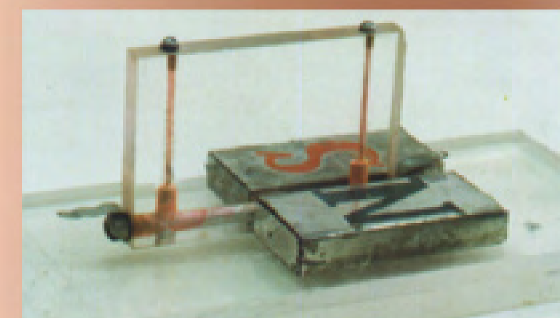
In the middle of two magnets with the opposite poles (situated in one plane) the total vectorial magnetic field is equal to zero, that is proved by the absence of magnetic interaction between magnets and the ferromagnetic material. This ferromagnetic material is placed to the space, where the usual magnetic field is equal to zero. However, in the space, where the total vectorial magnetic field of two magnets is equal to zero, the total value of scalar magnetic field of two magnets is maximal. In spite of the fact, that the scalar magnetic field between the magnets is maximal, this field do not interact with ferromagnetic materials. That is why the ferromagnetic material on the tray is not attracted to the magnets. However if we create electrical currents (or equivalent Amper's currents of this double magnet) in this space, where usual magnetic field is equal to zero, than under the action of longitudinal magnetic interaction of these currents with the total scalar magnetic field of the magnets the forces of attraction or repulsion appear.



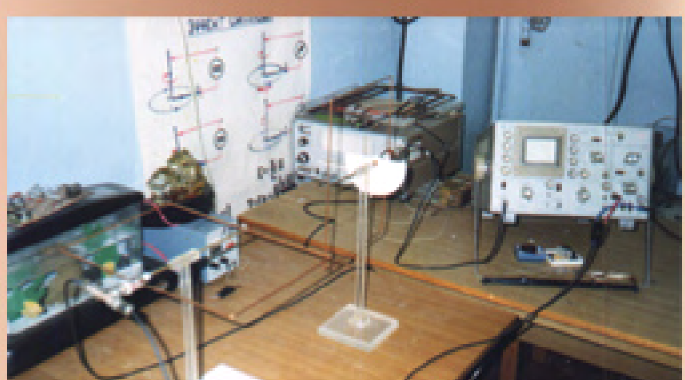


It is a device to demonstrate the interaction of scalar magnetic fields between each other. The constant current is created through the axis of two toroids made of ferromagnetic material (Armco). The whole usual magnetic field is concentrated only inside the toroids. That is why the toroids should not interact. However, there are the scalar magnetic fields unequal to zero outside the toroids. The toroids are attracted to each other under the action of these fields.

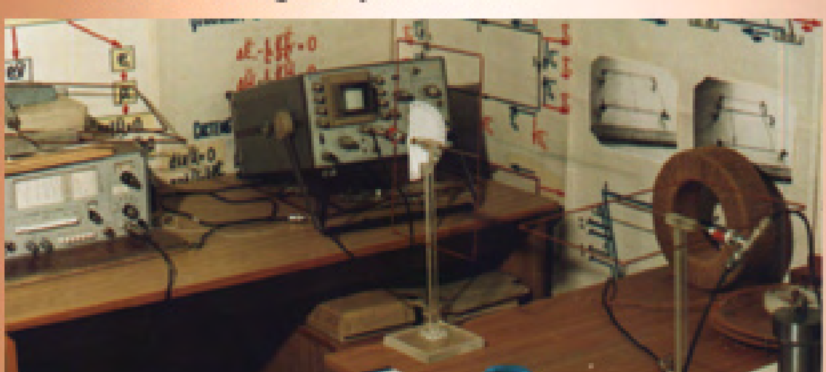


This device demonstrates forces of longitudinal magnetic interaction. Usual magnetic fields are compensated in the space between two flat magnets, while the scalar magnetic fields have the maximal value. The liquid conductor (bismuth-alloy) is placed in this space. There is an electric current. The longitudinal forces act on the current in the conductor. The level of liquid in vertical channels increases from one side and decreases from the other side under this action. With the change of direction of current the levels of liquid in the channels will change to the opposite one.

"Magnetic potential hole". There are forces of longitudinal magnetic repulsion between two magnets attracting to each other (or between two circuits with the current) as well as the forces of transverse magnetic attraction. According to well known theoretical notions about one magnetic field it is not possible to create a magnetic potential hole in the static magnetic fields. But using the properties of scalar magnetic field we will be able to realize the conditions of magnetic potential hole.



It is a device to demonstrate the existence of longitudinal electromagnetic waves. Two loop antennas are emitting the antipodal waves. That is why the total signal of transverse electromagnetic waves in the plane between the loops is equal to zero. However, the longitudinal electromagnetic waves have the maximal value in the plane between the loops. These waves are easily registered by the loop antennas, even in spite of the fact, that the plane of the loop antennas appears to be perpendicular to the plane of polarization vector of transverse electromagnetic waves. Any registration of transverse electromagnetic waves is impossible in this case.



One more experiment on the longitudinal waves

NEW CONCEPTS OF THE PHYSICAL WORLD

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New concepts of physical world and new consistent electromagnetic theory of physical vacuum, which includes two kinds of magnetic fields and magnetic interactions, are proposed by Dr. Nikolaev, Tomsk. These concepts were made by the author on the basis of general theoretical analysis of principles of modern fundamental physics. Existence of scalar magnetic field, which was unknown before and phenomenon of longitudinal magnetic interaction was established by theoretical and experimental research. The result of the obtained system of differential equations of electrodynamics is the possibility of existence of longitudinal electromagnetic waves. The reality of their existence was proved experimentally. New physical phenomena and effects of electrodynamics of physical vacuum can have a wide applied significance for various fields of science and techniques. Wide perspectives are opened for the creation of energy systems on the principally new basis as well as new type of nonreactive principles of motion, methods of communication using the longitudinal waves and dynamic effects of electromagnetic medium of physical vacuum.

Illustrating the importance of the role of the laws of electromagnetism in the life of Humankind, Richard Feynman wrote: **"From a long view of the history of mankind - seen from say, ten thousand years from now - there can be little doubt that the most significant event of the 19th century will be judged as Maxwell's discovery of the laws of electrodynamics. The American Civil War will pale into provincial insignificance in comparison with this important scientific event of the same decade".** [1]

Nowadays, the areas of application of the laws of electromagnetism by mankind are so tremendous that any reasonable estimation of their significance has become impossible. Maxwell's electrodynamics equations were formulated more than a century ago (in 1873). Their tremendous importance is emphasized by the fact that the general form of Maxwell's equations has remained practically unchanged up to the present day.

However, during this long period of mastering the laws of electromagnetism, electrodynamics has accumulated a huge number of unexplained, strange, paradoxical, often surprising, and in some cases frightening electromagnetic phenomena, whose nature remains for us, mysterious and in many respects unclear. As a result a person will realize her/his complete powerlessness before the laws of Nature when, as is described below, she/he experiences this phenomenon on her/his body.

What are these strange natural phenomena? Certainly, the person who was "lucky" enough, to observe any such natural phenomenon, retains a memory of the event for the rest of her/his life. The person not only retains this memory, but is constantly reminded that in Nature there exists some terrible unbridled force, before which all living beings on the Earth are absolutely powerless. We are able to discuss these phenomena at length due to the fact that the author has been engaged in the special study of such phenomena for a very long time. One example, of such strange electromagnetic phenomena is described below in magazine ***Engineering-Youth*****, No. 1, 1982:**

"1978 (August). Mountains of Western Caucasus. A group of five persons coming down a mountain, stopped for the night at a height of 3,900 m. All were already asleep in a tent, when a bright yellow ball approximately the size of a tennis ball appeared in the tent. The ball had killed one of the five persons, most likely because his sleeping bag was laid on a rubber mattress and was isolated from the ground. The "BL" had no effect on the radio set, carbines, or alpine sticks. The size of input holes in the sleeping bags did not exceed that of a tennis ball, but the wounds measured 15-18 cm.

What was this phenomenon? An ordinary ball lightning we have heard of and discussed often. However, the behavior of this Ball Lightning was purposeful and too rational and logical in order for it to be natural.

This phenomenon was studied in detail by the Moscow AF Group, and the sweater of an eyewitness victim of these tragic events was shown to me when I had a meeting with V.N. Fomenko, a member of this Group. The sweater was woolen, and a hole with a diameter of 5-6 cm was burned in it near the waist. The hole was obviously burned out, because a thermal effect on the sweater material was seen on its edges, but that effect was surprisingly tiny. To imitate this phenomenon, researchers burned out other holes by different well-known methods (using a gas or a plasma burner, laser beam, etc.), but they failed to obtain anything similar. In all cases, the woolen material swelled under the

effect of heat on the sweater. The researchers failed to produce such a tiny burned edge. The nature of this phenomenon is still unknown to us. We do not know what fields produced this effect, and we do not know the nature of the luminous ball itself.

Thus, on the one hand, we have "the greatest achievement of the humankind" - the famous Maxwell's electrodynamics equations, and on the other hand, we are absolutely helpless when confronted by strange electromagnetic phenomena of the above-mentioned nature.

What is the problem here? What other very important factors we do not know about the laws of electromagnetism? Why do these natural electromagnetic phenomena seem so mysterious to us? If our knowledge of the laws of electromagnetism is actually far from being complete, what are the principal points in our knowledge of these laws, which have been overlooked? Meanwhile, the present day version of Maxwell's electrodynamics, according to official academic science, is considered to be the basis for all modern physics.

However, if we have actually overlooked something in our modern picture of the laws of electromagnetism, this omission was obviously made in the days of Maxwell and perhaps by Maxwell himself!

But is it really reasonable to reproach Maxwell if he himself in his time explicitly recognized **that the system of electrodynamics equations that he developed was incomplete?** [2]

It is most likely that at the present time only a few scientists know that after having written down his famous electrodynamics equations, Maxwell discovered that something was missing in his equations. He wrote (which means that he warned scientists!) **that the system of his equations is incomplete, and that, more specifically, they would be inapplicable, in the case of non closed (open) currents, for current elements (segments of current), and especially for single individual charges.** Ball Lightning, for example, whose nature is still unknown to us, are supposed to consist of isolated moving electric charges or a charged cluster. Hence, our understanding of the laws of electromagnetism was and still today remains incomplete and therefore highly limited. For that exact reason, many manifestations of BL and other natural electromagnetic phenomena seem strange, mysterious, and even terrifying to us.

Maxwell's equations were based on the Faraday's concepts that presume that there exists a magnetic field of a moving electric charge and that lines of magnetic force and that magnetic interactions between currents (more specifically, the phenomena of transverse magnetic interactions) exist as well. **The experimental evidence available in the days of Faraday was obviously not sufficient, because something was missing in Maxwell's equations.**

However, other experimental facts and approaches were known in the days of Maxwell. In particular, Ampere, put forward the **opposite concept,** based on the experimental data available at that time **- that <u>magnetic fields</u> and <u>magnetic lines of force</u> do not exist in Nature, but instead that in addition to transverse interaction forces, longitudinal interaction forces do exist.** Ampere's concept obviously could not be integrated into Maxwell's mathematical framework, which consists of equations describing electric, and magnetic fields. It was for this very reason that Maxwell could not understand the essence of Ampere's suggestions. At the same time the suggestions of Ampere contained a deeper understanding than that of Maxwell, which unravels the actual reasons for the limitations of Maxwell's system of equations of electrodynamics. **At that early time Ampere expressed a surprisingly sharp and visionary statement that: "If one does not abandon the concept of the magnetic field in electrodynamics, it will result in a tremendous confusion in future theory. "** And in the present day, based on a general analysis of the available theoretical and experimental evidence, we are able to see for ourselves the real truth of Ampere's visionary statement. In addition, we now know that only the electric field of a stationary charge exists, and no special **"magnetic field"** appears when one considers the moving electric charge. Instead there is only the same electric field of the electric charge, but slightly deformed, altered (the well-known effects of retarded potentials!) due to its motion in the medium of the physical vacuum. Thus, the erroneous fundamental assumptions (of Faraday) provided the basis for the fundamental physical premises of Maxwell's electrodynamics. In brief, Maxwell was misleading by incorrect or incomplete concepts of the laws of electromagnetism previously established by others.

However, actual practical demands often require that physicists solve problem of the elements of open currents and problem of single moving electric charge. **In the history of mathematics, it is well known that the creators of the theory attempt to fix any shortcomings of the physical theories (uncertainty and inaccuracy in the initial fundamental premises) through us of the means of mathematical formalism. The modern mathematical methods of Maxwell electrodynamics is a perfect example of this approach, since being modified in this way Maxwell's theory has become intrinsically inconsistent and full of paradoxes.** Physicists using purely formal methods of mathematical substitutions of all kinds, imposing additional arbitrary normalization conditions, using gauge theories, introducing primed coordinates and special d-functions, etc., have succeeded in "stretching" Maxwell's equations and adjusting them to certain classes of problems and in this manner obtained results that outwardly appear to be in agreement with the experimental observations.

For example, let us assume that we must solve the simplest problem - to determine the magnetic field strength created by a single moving charge at a given observation point - using the system of Maxwell's equations. This problem is the simplest possible one. However, Maxwell's equations are inapplicable for solving this problem (this was pointed out by Maxwell himself!), because div**A** in this case cannot be taken to be equal to zero. In order to "stretch" Maxwell's equations and to make them applicable in this region of inapplicability using solely mathematical formal methods, this elementary problem must *a priori* be made purposefully (or deliberately!) complicated. It turns out that in accordance with the formal requirements, we must assume that the problem to be solved is not elementary: not a single moving charge, but a system of moving charges which constitute closed currents (or current loops). Now since Maxwell's equations are applicable in the case of the introduced closed currents (or current loops) one can impose additional formal restriction div **A** = 0. By doing this, the system of Maxwell's equations can easily be reduced to the Poisson equation for the vector potential **A**, which can be solved (with the use of the formalisms of primed coordinates and δ-functions). Once the solution for the vector potential **A** is found, one can calculate the expression for the magnetic field **H** at the observation point by taking a partial derivative in the form of rot **A**. The expression obtained thus far is in agreement with the experimental data. As a result one comes to the conclusion that the correct solution was found by following this system of equations.

The correctness of a solution of any equation can be verified by simple substitution of the solution obtained into the original equation. However, upon substituting the result obtained through solving this system of equations into the original Maxwell's equations, one will find out that the right side of the equation is not equal to its left side. This simple verification effectually shows that the solutions of the system of Maxwell's equations obtained with the use of these formal methods are incorrect. This is the consequence of using of purely formal-mathematical methods in order to overcome the intrinsic limitations imposed by the system of Maxwell's equations itself.

Moreover, if one takes the solution of the Poisson equation to be the field of the vector potential **A** thus obtained and then takes another spatial derivative of this vector potential div**A** (recall that in **the additional conditions** one did specify div**A** = 0!!!), one will find out unexpectedly that div**A** is nonzero: div**A** ≠ 0, that is, one has obtained a result which is in contradiction with an *a priori* **additional condition** artificially introduced at the beginning of the analyses.

Furthermore, another outstanding discovery of Maxwell was the introduction, into the right hand side of his equations, strange "displacement currents" in addition to the usual convection currents, whose physical meaning is argued by physicists even up to the present day. Maxwell believed that displacement currents really do exist, that is, they represent real displacement currents in ether. Unfortunately, after the triumph of Einstein's concept of "empty space," (no ether) the displacement currents introduced by Maxwell completely lost their physical meaning.

According to modern concepts of electrodynamics, on the one hand, it is accepted that **displacement currents are physically real, since without them it is impossible to understand the functioning of an elementary capacitor**. On the other hand, **the displacement currents are a mathematical formalism, which has no physical meaning. At the same time, with their help it appears possible to make Maxwell's equations symmetrical [see E. Parcel and V. G. Levich]**. On the one hand, **the magnetic properties of the displacement currents are accepted as being equivalent to those of the convective currents, because "these currents identically enter into the right side of Maxwell's equations [see I. E. Tamm]."** On the other hand, **the magnetic fields of moving charges are determined, for an unknown reason, by taking into account only convective currents and completely neglect displacement currents as if they do not exist**. At the same time it appears absolutely impossible to write down Maxwell's equations without utilizing the concept of displacement currents.

In the present day, it seems that the physical existence of displacement currents is revived (resurrected again) due to the common recognition of the central role, which the physical vacuum plays in all electromagnetic phenomena. Nevertheless, Maxwell's equations have not yet been solved (**based on the physical principle of local action**) in terms of the displacement currents in physics and the magnetic fields are expressed solely through convective currents (**based on the non-physical action at a distance principle**).

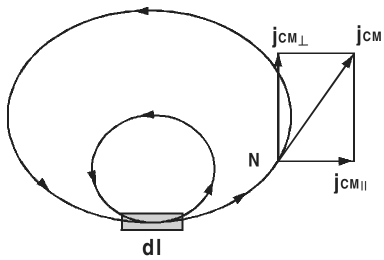

Fig. 1.

It is well known that displacement currents in the vicinity of a moving charge (or an element of linear current) are closed by convection currents (See Fig. 1). Moreover, the direction of the vector of the displacement-current density $\mathbf{J}_d(\mathbf{r})$ at an arbitrary point in space, in general, does not coincide with that of the charge motion. **Thus, at this point in space it is reasonable to assume that at any point one can determine both the magnetic field strength H(r) and the corresponding displacement current $\mathbf{J}_d(\mathbf{r})$.** Despite the fact that the concept of the displacement current has been in use in electrodynamics for a long time, in practice, the magnetic fields at the observation point

are still determined in terms of the convection currents utilizing only the nonphysical "action at a distance" principle.

The very first attempt to express the magnetic field in terms of the displacement currents gave a rather unexpected result. **It was established [3] that the axial component of the vector of the displacement current density $J_{||\,d}(r)$ determines completely (previously well known in science) the vector magnetic field $H_\perp$ at the observation point:**

$$H_\perp(r) = 2J_{IId}(r)/r_0$$

while, the radial component of the displacement current density $J_{\perp\,cm}(r)$ generates an additional (previously unknown in science) scalar magnetic field $H_{||}$ at the same observation point:

$$H_{||}\,(r) = 2J_{\perp d}\,(\boldsymbol{r})\,/\,x_o.$$

Hence, contrary to the assumptions of Maxwell and Faraday, there are two, rather than one, type of magnetic field at any point in space in the vicinity of the moving electric charge. At this point the reason for the limitations imposed by the system of Maxwell's equations becomes clarified.

Moreover, the same conclusion about the existence of two types of magnetic field in space in the vicinity of a moving electric charge can be derived immediately using the formalism of the vector potential field known in electrodynamics. It is well known that the vector potential field $\mathbf{A}(\mathbf{r})$ is induced in space in the vicinity of the moving electric charge and that the magnitude of this vector potential is a **spherically symmetric function**. If one takes the first spatial derivative of the vector potential field rot$\mathbf{A}$, one will find the vector magnetic field $\mathbf{H}_\perp$ that is well known in science. This vector magnetic field has a radial distribution in the vicinity of the charge (Fig. 2).

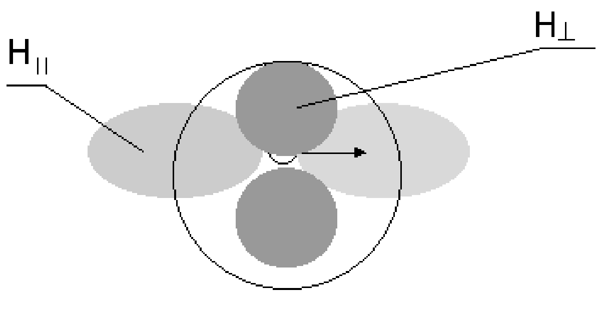

Fig. 2.

However, vector magnetic field $\mathbf{H}_\perp$ vanishes both in the direction of motion of the charge and in the opposite direction, even though the magnitude of the vector potential in these directions remains non zero. **But in mathematics, it is well known that the only spatial derivative rotA does not completely determine the vector A, until the additional derivative of this vector, namely, divA, is specified.** It appears that the second derivative **divA** of the vector potential **A** for any moving charge (and also for any current element or any open current - that is, in the cases that Maxwell warned us about!), as is known [4], is also nonzero: div$\mathbf{A}$ = $H_{||} \neq 0$. Moreover, it is measured in physical units of Oersted and defines an additional, previously unknown, scalar magnetic field $H_{||}$ in the vicinity of the moving charge. This scalar magnetic field in the vicinity of the moving charge is concentrated mostly in the direction of motion of the charge and in the opposite direction (see Fig. 2), where there are no conventional vector magnetic fields. Only the superposition of two fields: vector and scalar magnetic fields give a complete pattern of the resultant magnetic properties of any moving electric charge. Once the basic concepts of the complete magnetic properties of a moving electric charge have been established, practically all presently known theoretical and experimental contradictions and paradoxes in modern electrodynamics can be resolved.

Finally, **the well-known physical paradox in electrodynamics of the violation of the third law of Newton's mechanics in the case of the interaction of two electric charges moving in two orthogonal directions (or the interaction between two orthogonal current elements) can be resolved,** once the magnetic field of the second type is taken into consideration. Physicists have been faced with this paradoxical situation for a long time; however, the problem has not yet been resolved. At the moment when the test electric charge is crossing the trajectory of the first charge, no magnetic force acts on the test charge, because the conventional vector magnetic field vanishes in the direction of motion of the first charge. Meanwhile, the nonzero transverse Lorentz force, created by the test charge, acts upon the first charge. **But it is exactly the direction of motion of the first charge, in which direction the second scalar magnetic field $H_{||}$ acts, and whose action upon the first electric charge creates an equal and opposite longitudinal response force, that force has its maximum value in complete correspondence with the third law of Newton mechanics (action and reaction).**

A large number of real electromagnetic systems, working models and devices, whose functioning is explained on the basis of the assumption of possible violation of the third law of mechanics in the magnetic interactions of current-carrying elements, have now been accumulated in electrodynamics. Several hundred working devices which clearly demonstrate violation of the third law of Newton's mechanics were made by R. I. Sigalov, a physicist from Fergana and described in [5]. However, a non-contradictory explanation of all these experiments becomes possible under the assumption of the existence of an additional magnetic field corresponding to an additional longitudinal magnetic interaction.

Taking into account the existence of a scalar magnetic field of a moving charge **it is possible to resolve the paradox of the kinetic energy of the moving electron charge, which has been known in physics for a long**

time. The essence of this paradox is that the work $A = Ue$, spent in accelerating the electron to the velocity V is equal to the kinetic energy $W_K = mV^2/2$ acquired by the electron. However, the electron moving with the velocity V in addition to kinetic energy also acquires the magnetic field energy $W_H = (2/3)W_K$ upon which apparently no work has been spent. **Physicists once again were faced with a paradoxical situation and were required to seek for a way out from it.**

In order to resolve this paradox, physicists usually assume that the energy of the magnetic field of electron W_H is included in the electron kinetic energy W_K. Attempts were undertaken by physicists to change the charge density distribution over the volume of the electron; however, physicists failed to obtain conservation of energy. In addition, the above-indicated assumption violated the integrity of the theoretical model of the electron, because it was necessary to assume that 1/3 of the electron mass has a purely mechanical origin, while 2/3 of electron mass has a purely electromagnetic nature. To find a way out from this paradoxical situation, the great physicist Ya. I. Frenkel [6] suggested that the total electron mass (rather than a portion of it) should have purely electromagnetic origin. However, the exact equality has not yet been found within the framework of the existing concepts. **Meanwhile, taking into consideration the energy of the scalar magnetic field of the moving charge of the same electron, this quantity turns out to be equal to the energy $W_H = (1/3) W_K$, and the required identity $W_H \equiv W_K$ is easily obtained.** This identity is very important for basic physics. **The electron mass turns out to be of purely electromagnetic origin, as Feynman assumed.** Unfortunately, the more fundamental conclusion following from the above conclusion: **the principle of equivalence of mechanical and inertial masses** is actually not valid in nature.

It should be noted that after introducing into physics the concept of electromagnetic inertial mass, the violation of the equivalence principle (between electromagnetic inertial and mechanical inertial masses) has become obvious from the physical viewpoint. The point is that the total gravitational mass and inertial mass are linear functions of the number of particles, whereas the inertial electromagnetic mass is not a linear function of the number of particles. Instead, for the high velocities it behaves as a quadratic function of a number of particles. (**For example, ten particles of mass m_o have a total mass of $10m_o$, whereas ten electromagnetic masses m_{el} of the same 10 particles have the total inertial electromagnetic mass $M_{el} >> 10m_{el}$, namely, on the order of $100m_{el}$).**

In real natural solid-state materials, having a much larger density of charged particles, their electromagnetic inertial masses can differ from the mechanical gravitational mass by more then ten orders of magnitude. **For example, the inertial electromagnetic mass of a single conductivity electron in the crystal lattice of a conductor is equal to the gravitational mass of about 10^7-10^8 protons, that is, it can exceed by more than 10^{14} times the mechanical mass m_o of this electron [7].**

The difference between the mechanical and electromagnetic masses of electric charges turns out to be even more dramatic; however, a question immediately arises: How real is this difference? It is most likely, that Humankind does not encounter these phenomena in explicit forms in everyday practice, but some natural electromagnetic phenomena amaze us with their strange manifestations.

As numerous observations show, most Ball Lightnings (BLs) do not carry an electric charge at all, but nevertheless some strange force effects are actually observed. Some BLs are the sources of a very strong magnetic field of tens of millions of gauss. Moreover, they can produce the corresponding force effects. For comparison, it should be noted that mankind has mastered a magnetic field strength of only up to 1 million gauss obtained during a very short period by the explosion of coils with high currents. Whereas in the case of the small ball of BL the magnetic field strength which is several orders of magnitude higher is retained for a long period of time - for several tens of minutes and even longer. This strong source of a magnetic field near conducting or semi-conducting bodies engenders high-power interaction force effects upon these bodies. However, when the BL is observed in Nature, its force effects appear so strange that they have no reasonable explanation within the framework of the well-known "basic" laws of electromagnetism. In this case, it becomes obvious that we have overlooked something in these basic laws.

An experiment with a copper pendulum swinging between the poles of a strong electromagnet is known to all of us from our school days. When the electromagnet is switched off, the pendulum swings freely. However, with the electromagnet switched on, the copper pendulum decelerates quickly and stops between the poles of the magnet, as though it is located in a dense medium. We have an explanation for this experiment within the framework of modern concepts. As the copper pendulum approaches the poles of the magnet, high Foucault currents are induced in it, whose interaction with the magnet creates a force that opposes the pendulum motion. This phenomenon can be easily inverted. If the copper pendulum is fixed and the magnet approaches it, the magnetic field will push the pendulum in the direction of motion. However, when the magnet moves away from the copper pendulum, the magnetic field of the magnet begins to entrain the copper pendulum. All this fully agrees with the well-known theoretical concepts of the laws of electromagnetism.

At the same time, it is well known that if we place a piece of iron near the magnet, it simply will pull the iron and attach itself to it, so that the piece of iron will remains fixed with respect to the magnet even when moved in an arbitrary way. All this is well

known to us and is beyond question. However, in actual cases where natural BLs were observed, their force effects were so strange that they have defied any reasonable explanation within the framework of the well-known laws of electromagnetism. Hence, it becomes even more obvious that we have overlooked something important in these basic laws.

For example, in one case a BL flew along a wooden fence. Boards were broken away from the fence one by one and fell down in disorder; however, the BL itself continued to fly strictly rectilinearly, as though the boards were not broken away from the fence by the BL itself. That is, the force effect of the BL on these boards was manifested without any counter effect from these boards on the flight path of the BL.

Another eyewitness witnessed an interesting force effect of a BL on nails that he hammered into boards that he was nailing into a wall. In order to properly place the boards on the wall, the eyewitness hammered the nails partially into the wood. When all the boards had been partially nailed into the wall, the eyewitness began to hammer the nails completely into the wall. However, he had completely hammered in only one nail when suddenly a BL appeared, flying toward the wall. Quite naturally, the BL attracted his attention and interrupted his work. When the BL had disappeared, the eyewitness turned to continue his work, but found out that all the nails had already been knocked completely into the wall.

In another case, a BL flew by in the immediate vicinity of an incandescent lamp, which exploded. If the BL, as many scientists believe, had had the density of air and had been a weightless formation, vibrations produced by the explosion of the lamp bulb would have led to a change in the BL trajectory; however, nothing of the kind happened.

> ***...when taking into consideration the actual existence of this second scalar magnetic field, rather unusual magnetic nature and strange and mysterious behavior of the BL magnetic fields can be fully understood.***

On another occasion, a bellman who served in a church tolled a bell at the assigned time as he usually did. He pulled the rope, but heard no sound from the bell. The bellman was surprised and went out into the street to look at the bell, to see if something had happened to it. When he looked upward, he saw a bright luminous BL suspended near the bell. Moreover, the bell and its tongue remained fixed even when the tongue was pulled by the cord. The bell remained in this state until the BL disappeared. As soon as the BL disappeared, the bell began to ring as it normally did.

The violation of well-known physical laws was especially evident and observed in the well-documented case of the Gal'tsov phenomenon investigated by the Tomsk Group of Anomalous Phenomena.

A spherical lightning about the size of a football ball flew above a village at a height of twenty to thirty meters. The first shed in its way, with ferroconcrete poles, was crushed and collapsed. Flying above a house covered with an asbestos cement roof, the BL tore away the roof of the house together with nails (from an area of several hundred square meters), and after the entire roof had been raised into air, the BL entrained it, and then scattered its parts all over the village.

Flying above a tractor station, the BL crushed a frame welded from metal angle iron, covered with a tarpaulin. Another frame first trailed along the ground when the BL approached it, and when it had moved above the frame, it was lifted by the BL and carried at a distance of 300 meters. The frame weighed no less than 100 kg.

Let us now analyze this case based on well-known physical laws. The flying BL carried by its fields (that are obviously non-electric in nature) the frame whose equivalent weight was hundred kilograms. It is quite obvious that the frame also exerted the same force of hundred kilograms on the BL. However, the BL, for some unknown reason, continued to fly strictly along the straight line, not even noticing that a metal frame weighing hundred kilograms was attached to it. If the BL, as is commonly accepted, is a light formation (having a small mass), why did the frame, weighing a hundred kilograms, cause no changes in the trajectory of its flight? We can ask many "why's" here.

Why does the BL's behavior seem so strange to us? If our concepts of the laws of electromagnetism are actually incomplete, which phenomena have been overlooked in our concepts of these laws? In our case with the BL, the effects of the Foucault induction currents in conducting materials and the subsequent effects of the strong magnetic field of the BL on these currents were clearly manifested; however, the magnetic field of the BL did not pull the frames constructed from iron angle bars to the BL! Numerous observations of BLs have not revealed even a single case where any metal iron objects were pulled to the BL. Thus, it follows that all our notions of the laws of magnetism appear to be completely inapplicable to the BL.

Numerous experiments have already demonstrated that the second scalar magnetic field of a moving charge have induction properties just as does the conventional vector magnetic field. However, an unexpected and surprising property of the second scalar magnetic field is that unlike the conventional magnetic field, this magnetic field does not interact with ferromagnetic metals. And it is only now, when taking into consideration the actual existence of this second scalar magnetic field, that the rather unusual magnetic nature

and the strange and mysterious behavior of the BL magnetic fields can be fully understood.

Hence, the BL is not only a set of isolated single charges to which the equations of Maxwell's electrodynamics are inapplicable (and which Maxwell warned us about!). In addition, the BL turns out to also be an ideal source of the scalar magnetic field that still remains unknown to science. This field was overlooked by Maxwell and as a result the scalar magnetic field is not accounted for in Maxwell's equations of electrodynamics. And only now we can understand why Faraday could not register the scalar magnetic field during his numerous experiments on the defining of magnetic field with filings.

Over the long period of the existence of electrodynamics, a great number of theoretical and experimental evidences have been accumulated, so that even within the framework of existing concepts one can easily prove that the longitudinal magnetic forces actually do exist [3]

For example, within the framework of the generally accepted Lorentz force concept, no magnetic interaction should exist between two elements of the current if they are oriented along the same straight line, that is,

$$F_L \equiv 0, \tag{1}$$

since the well-known to science vector magnetic field **H** created by these currents is absent in the direction of these currents. However, if one, for example, uses the expression for the energy of interaction between the magnetic fields $\mathbf{H}_1$ and $\mathbf{H}_2$ created by these two currents, which is given by the formula

$$W = \frac{2}{8\pi}\int \mathbf{H}_1\mathbf{H}_2 dV \tag{2}$$

he will find that the total interaction energy of two elements of the current oriented along the same straight line is nonzero and depends on the distance between them. It then immediately follows that a nonzero longitudinal force of magnetic interaction should exist between two current elements oriented along the same straight line

$$\mathbf{F}_H = \frac{\partial W_H}{\partial t} \neq 0 \tag{3}$$

Moreover, if one again uses the well-known formalism in electrodynamics of the vector potential **A**, for interaction energy of two electric charges e_1 and e_2, moving along the same straight line, one obtains

$$W_A = \frac{1}{C}\left(\mathbf{A}_2 e_1 \mathbf{V}_1 + \mathbf{A}_1 e_2 \mathbf{V}_2\right) \neq 0 \tag{4}$$

Hence it follows that

$$\mathbf{F}_A = \frac{\partial W_A}{\partial t} \tag{5}$$

that is, the force of longitudinal magnetic interaction between two charges moving in one direction is nonzero. However, one can compare Eqs. (1), (3), and (5) to show that

$$F_A > F_H > F_L \equiv 0 \tag{6}$$

and all the results obtained give significantly different magnitudes for the same physical phenomenon. Thus, from Eq.(6) it clearly follows that the existence of the nonzero longitudinal magnetic interaction force is established even within the framework of the well-known concepts by using different methods of calculation. If in the procedure of calculation of forces (1), (3), and (5), one takes into account the scalar magnetic field $H_{||}$, all the above-considered methods will give the same result for the force of the longitudinal magnetic interaction, that is,

$$F_A = F_H = F_L \neq 0 \tag{7}$$

The existence of the force of longitudinal magnetic interaction of a moving electric charge with a scalar magnetic field can be easily proven, for example, by considering the effects of magnetic interaction of a moving charge e with a field of vector potential **A** (or with a scalar magnetic field $H_{||} = -\mathrm{div}\mathbf{A}$) of a toroidal coil with a current under conditions then the conventional vector magnetic field $H_\perp = \mathrm{rot}\mathbf{A}$ is absent in the space outside of the toroidal coil.

It is well known that the magnetic field $H_\perp$ of an ideal toroidal coil is placed completely inside the coil. Outside the toroidal coil, there is only the nonzero field of the vector potential **A**, for which we have

$$-\,div\,A = H_{||} \neq 0 \tag{8}$$

When a charge moves in the field of the vector potential **A** of the toroidal coil (see Fig. 3), the following types of magnetic force interactions can be identified within the framework of well-known generally accepted concepts:

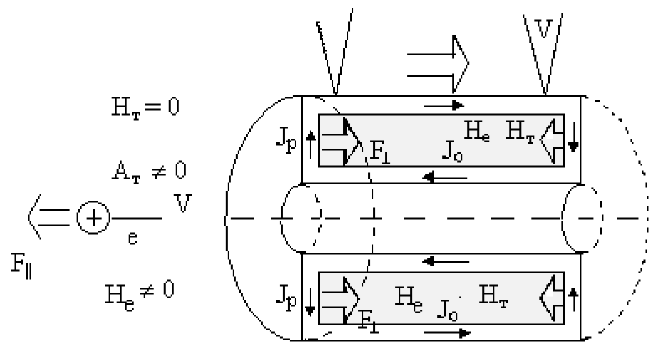

Fig. 3.

1. When the charge e moves along the axis of the toroidal coil with a current, the conventional magnetic field H_e, induced by moving charge e, penetrates into the toroidal coil, acting on neighboring radial currents in the conducting wires of the coil and creating the trivial

forces of the transverse magnetic pressure $F_{\perp}$. In addition, when the charge *e* moves in the field of the vector potential $\mathbf{A}_T$ of the toroidal coil, the energy of interaction with the vector potential field of toroidal coil can be easily obtained

$$W_T = \frac{1}{C}\mathbf{A}_T e_1 V_1 \neq 0 \qquad (9)$$

that is resulting in the nonzero longitudinal magnetic force

$$\mathbf{F}_T^{\parallel} = \frac{\partial W_T}{\partial t} \qquad (10)$$

Hence, the total force of the magnetic pressure exerted by moving charge *e* on the toroidal coil (neglecting the interaction with distant current-carrying wires of the toroidal coil) may be expressed in the form

$$F_o = F_{\perp} + F_{||} \neq 0 \qquad (11)$$

2. A nonzero value of the force of longitudinal magnetic interaction between moving charge and field of the vector potential **A** of the toroidal coil can also be derived from the energy of interaction between the magnetic fields of the moving charge $\mathbf{H}_e$ and the magnetic field of the toroidal coil $\mathbf{H}_T$ inside of the volume of toroid.

$$W_{\perp} = \frac{2}{8\pi}\int \mathbf{H}_e^{\perp}\mathbf{H}_T^{\perp} dV \quad \text{and}$$

$$W_{\parallel} = \frac{2}{8\pi}\int H_e^{\parallel} H_T^{\parallel} dV \qquad (12)$$

It follows then that the longitudinal magnetic interaction forces will act between the charge and the toroidal coil

$$\mathbf{F}_T^{\parallel} = \frac{\partial W_{\perp}}{\partial t} + \frac{\partial W_{\parallel}}{\partial t} \qquad (13)$$

3. Because the electric charge *e*, entering into the toroidal coil, will increase or decrease the magnetic field inside the toroidal coil, induction electric fields will be induced near the toroid. They will either decelerate or accelerate the charge motion in accordance with the well-known Faraday's law of induction

$$\varepsilon = \oint \mathbf{E} dl = \frac{1}{C}\frac{\partial F}{\partial t} \qquad (14)$$

4. If one considers the interaction of the moving electric charge with the current-carrying toroidal coil in the system of coordinates of the moving electric charge, then in the coordinate system of the charge, the eddy electric field will be induced by the vector potential **A** of the toroidal coil, which is time dependent, according to the well-known electrodynamics formula

$$\mathbf{E} = -\frac{1}{C}\frac{\partial A}{\partial t} = -\frac{1}{C}(\mathbf{V}\nabla)\mathbf{A} \neq \mathbf{0} \qquad (15)$$

The action of the eddy electric field **E** on the electric charge will create a nonzero longitudinal force in the direction of motion of the toroidal coil.

As one can see from Equations (9)-(15), the reality of the longitudinal force of the magnetic interaction between the moving electric charge and the field of the vector potential of toroidal coil can be easily proven within the framework of well-known concepts by several different methods. Taking into account that the examined problem of the interaction of the moving charge with the field of the toroid vector potential corresponds to the Aharanov-Bohm experiment performed by Japanese physicists [8], the above considerations may be considered as an alternative physical interpretation of positive results of the Aharanov-Bohm phenomenon. The positive results of the Aharanov-Bohm experiment may be explained by the conventional classical effect of variations in the velocity of the moving electric charge in the vector potential field rather than by quantum effects, as is commonly accepted by physics community. As a result, de Broglie's wavelength of a moving charge also is changed by the process of interaction. In addition one can conclude that the commonly accepted "fundamental" concept of the "wave - particle duality" (Niels Bohr Copenhagen School) is obviously unnecessary within the framework of new physical concepts.

There is no need to introduce the existence of a "wave-particle duality" in Nature, since the wave effects of moving particles may be naturally explained by the physics of the interaction of moving particles with the medium of the physical vacuum. Analogous wave effects are well known to arise in continuous material media when other material objects are propagating in it. They are manifested through approximately analogous physical dependencies (for example, the aerodynamic generation of sound in air, etc.).

Thus, as is seen, the well-known fundamental concepts underlying to the laws of electromagnetism turn out to be directly connected with many other commonly accepted concepts that are also considered to be fundamental, such as the principles of equivalence, principle of relativity, and constancy of the speed of light and erroneous concepts of the "particle-wave" duality, mass-energy inter-conversion accompanying annihilation of particles, concepts of special "magnetic" and "gravitational" fields, etc.

The basic philosophical (ontological) concepts of modern physics related to initial concepts of any physical theory, such as "space," "time," "matter," "mass," "gravitational mass," "inertial mass," "electromagnetic mass," "defect of mass," "dimensionality of space" and concepts of "time," "invariance of the laws of Nature," "invariance of equations," and so on and so forth, require serious and significant revision. The serious crisis situation in modern fundamental physics [9] is a direct

consequence of many commonly accepted concepts and dogmas of the modern "scientific perspective of natural phenomena". This crisis situation in modern physics is a direct consequence of many conservative scientific viewpoints, unfortunately supported and protected by modern official academic science. The evolution of our consciousness has been influenced by many undoubtedly well known experts and has been evolving for a long time in the environment of specific scientific vacuum and requires immediate revival. Even methods used for dissemination of new knowledge should be improved, if one actually wishes to accelerate the progress of Humankind.

The perspective for practical applications of new previously unknown scientific phenomena and effects looks very attractive, and they may be achieved by cooperative efforts of the human intellect. New breakthrough technologies of the 21st Century will require serious changes of many commonly accepted concepts and dogmas in fundamental physics. This process of progressive development cannot be stopped.

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Large-Scale Sakharov Condition

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Abstract

Recent far reaching theoretical results have used the quantum vacuum noise as a fundamental electromagnetic radiation field to derive a frequency (ω) dependent version of Newton's gravitational coupling term, $G(\omega)$. This paper reconciles the cut-off frequency with the observed cosmological constant, and then briefly puts forward a realizable laboratory test case in the 10 - 100 MHz frequency range. One analogy is drawn between the classical vacuum energy experiments with attraction between two closely spaced plates (Casimir cavity) and the arbitrarily dense material boundaries possible in Bose condensates, such as irradiation at MHz frequencies of superfluid helium or superconductors.

Theoretical Background

Zel'dovich [1] first suggested that gravitational interactions could lead to a small disturbance in the (non zero) quantum fluctuations of the vacuum and thus give rise to a finite value of Einstein's cosmological constant in agreement with astrophysical data. Using dimensional analysis and the suggestion by Zel'dovich, Sakharov [2] derived a value for Newton's gravitational constant, G, in only one free parameter, frequency, ω:

$$G \sim c^5 \Big/ h\int \omega d\omega \sim 1 \Big/ \int \omega d\omega$$

where c is the speed of light and h is the Planck constant. The free parameter in frequency when integrated over all values from zero to high frequencies must contain the usual integration cutoff value (Planck frequency on observable electromagnetic phenomenon).

Puthoff [3] and others [4 5] have extended Sakharov's condition in a relativistically consistent model to determine constants of proportionality. His model derives an acceleration term in first order expansion (in flat space time), then equates inertial and gravitational mass (by the equivalence principle) to make contact with the gravitational constant, G, directly as:

$$G = \left(\pi c^5 / h\omega_c^2\right) \sim 1/\int \omega d\omega$$

which is the Sakharov condition [2,3]. This paper revisits the meaning of the cutoff frequency, ω_c, for radiation interactions, of which the quantum vacuum [6-10] and